NIST
U.S. Department of Commerce
Director's Office/International and Academic Affairs Office (IAAO)

BIRD
U.S.-Israel Binational Industrial Research and Development Foundation

Date: 2021-05-13

REDACTED

BIRD Project Evaluation Form

1. General Information

U.S. Company: Aria Group

Israeli Company: Polarity Mobility

Project Title: Twin-Tail eVTOL prototype demonstrator and mass production planning

2. Budget

Project duration (months)	Israeli Company ($)	Israeli Company (%)	U.S. Company ($)	U.S. Company (%)	Total Budget ($)
20	1932702	52	1812724	48	3745426

3. Evaluation

Area	**Rating***	**Explanation** (expand below as needed)
Technology	B	The underlying technology appears to be sound, with some incremental yet interesting innovation potential.
Business Potential		(Not qualified to judge this aspect)
Capability of Companies	B	Companies appear to have the capabilities, and performed reasonable groundwork, for this project.
Overall Rating	B	Still some unknowns and uncertainties but seems like a worthwhile project.

* Rating: **A** = excellent, top proposal seen lately; **B** = good, high potential for success; **C** = fair, success with little innovation; **D** = problematic, lack details describing idea; **E** = recommend to reject, lacks details in multiple areas

4. Comments – (maximum three pages)

The Product and the Technology (Include description of the technological innovation, challenges and assessment of technological risks)

The primary innovations in this project are the combination of some existing technologies in somewhat novel ways.

First, is the addition of aerodynamic lifting surfaces to an otherwise conventional multirotor vehicle, so that forward movement also generates lift, in a manner that is more efficient than using the multirotor craft for lift. This is done with less complexity than most other designs, by utilizing stationary rotor placement that is a compromise between vertical and forward flight.

Second is the use of individual motor controllers, with integrated inertial sensing, to improve redundancy and self-compensating abilities in the event of a failure of the controllers.

There is some concern that the fault tolerance of the system may be overstated. For instance, the system claims to be able to deal with a loss of any one of the 8 rotors, which is reasonable. It should be clear that this only protects from failures in the controller and motor for that rotor. Failure of the power system (which is diagonally redundant) will cause more than 1 rotor to fail. Similarly, a failure upstream of the controllers will also cause failure of the vehicle. Furthermore, it is suggested that the CAN bus link between the independent controllers is non-essential, presumably because this is only to improve efficiencies by allowing the controllers to work together. If this is the case, the ability of the system to fly in challenging environments, and in various failure conditions, should be properly evaluated while this link has failed, as the lack of co-ordination between the controllers may introduce stability concerns.

The vehicle has no control surfaces to reduce complexity, and instead relies on differential power to the rotors to provide control in forward flight. This also means that in the event of a failure in the power or control electronics, this vehicle is unlikely to autorotate (which conventional helicopters can usually do to perform an emergency unpowered landing), nor glide in a controlled manner (which conventional fixed wing aircraft can usually do to perform an emergency unpowered landing). It is unclear if the additional safety measures introduced in this design compensate for the loss of these capabilities, and thus may add risk to certification and adoption.

Project Plan (Including major tasks, collaboration and share of responsibilities between partners, main milestones)

The project plan seems broadly reasonable and the project partners appear to be taking on roles that match their capabilities. This reviewer has limited experience in the specific manner of fabrication proposed to identify any of the more esoteric timeline risks. This reviewer is also unfamiliar with the impact of current and predicted pandemic-related disruption in supply chains on the components, equipment, and materials that will be required in this project to evaluate the additional risk that may be present.

The Budget (Realistic or not)

The budget appears to be broadly reasonable, however again this reviewer is less familiar with the current costs (particularly given the current and predicted disruption in supply chains) to comment further.

The Market (Including evaluation of commercial potential)

This reviewer is not so familiar with the current state of the market, particularly given the economic impact of the pandemic. It is suggested that in the current climate, particularly with the increased familiarity with remote working and meeting caused by the pandemic, that their demand figures may need to be revised and that perhaps the better market may be government and military.

Capabilities of the Companies (Technical & commercial)

Aria appears to have the requisite skills, experience, and facilities to perform the kind of manufacturing required for this project. Polarity are somewhat more unknown but they have presented examples of their previous work which suggests that they have the skills to further develop their existing underlying technology in an appropriate manner. Assuming that there is good communication between the two companies, their capabilities would seem to be appropriate for this project.

Production plans (Who, what, where, when, etc.)

Similar comment to project plan.

Benefit to the Israeli Company (If known)

Leveraging the expertise and experience of a large company that has the resources to bring an idea, tested in small prototypes, to commercialization.

Benefit to the U.S. Company (If known)

The opportunity to be the manufacturer of an innovative system with good potential.

Synergy between the Companies (If known)

The companies seem to have the complementary capabilities required to fulfill this project.

Pros (In your opinion)

- Strikes a novel balance between simplicity, redundancy/safety, efficiency, and vertical take-off/landing capability.
- Modest price point and yet seems to be reasonable due to the simplicity of the vehicle.
- Manufacturing process seems to be fairly low risk (notwithstanding the impact of the pandemic).

Concerns (In your opinion)

- Pandemic might have affected the business case for such a vehicle.
- The safety commentary may be slightly misleading.
    - While there are new, novel safeguards, some traditionally present safeguards are absence.

    - It is unclear if some of the redundant systems (e.g. power) will actually keep the vehicle in the air should one of the redundant systems fail.
    - The limits of the redundant controllers to deal with failures, and in particular the expected frequency of failures that can, and cannot, be dealt with is somewhat obfuscated.
- The proposal could benefit from some additional proofreading more generally.